Paddle for the Edge Quality Assurance Project Plan

January 2026

Barnegat Bay Partnership

Period of Applicability: October 2025 – October 2030

Version No. 2

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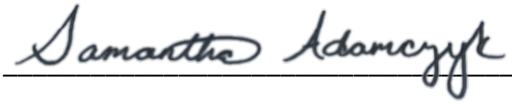

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BBP QA Manager: Andrew McGowan

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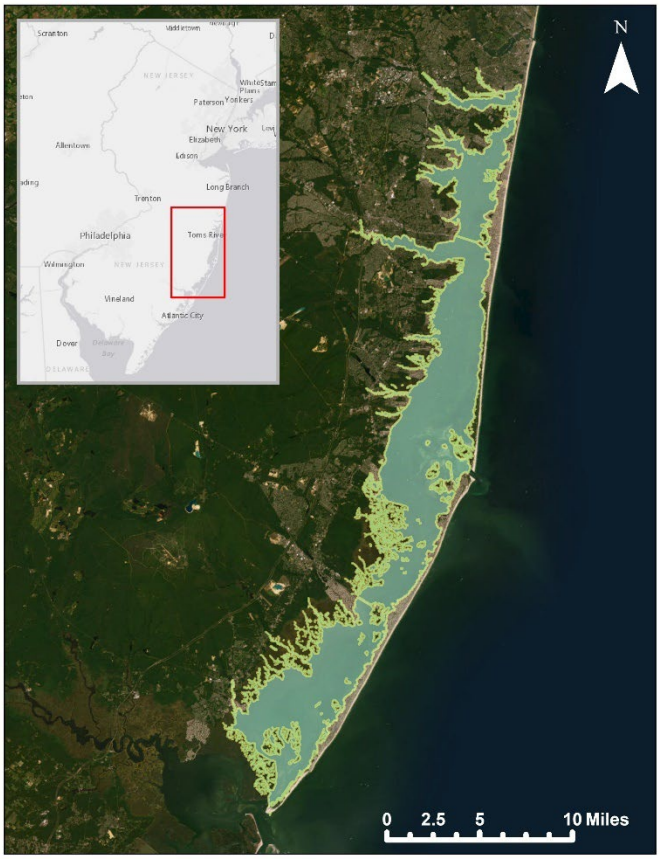
A4. Project Purpose, Problem Definition, and Background

Fringing tidal marshes provide critical ecosystem services such as flood protection, carbon sequestration, wildlife habitat, and water quality enhancement. Marsh loss has a “doubling effect” on carbon dioxide levels in the atmosphere due to an increase the atmospheric carbon dioxide as the decaying marsh is metabolized by bacteria and a decrease future carbon sequestration from the atmosphere into wetlands.

Barnegat Bay is a shallow lagoonal estuarine system along the Atlantic coast of New Jersey (Figure 1). In the Barnegat Bay estuary, most tidal wetlands have experienced significant human impacts and modifications over the last 100 years. Degradation and modification are occurring from all directions. Human development encroaches on salt marshes from the landward side. The interior of salt marshes experiences vertical loss through subsidence, erosion from flooding and storm surge, and mosquito ditching. However, perhaps the most telling indicator of development is that 45% of Barnegat Bay's shoreline is impacted by bulk-heading on the seaward side of the marsh (Lathrop et al. 1996, 2007; Figure 2).



One of the most substantial causes of wetland loss is that of erosion on the marsh edge due to excessive wave energy from increasing storms and boat wake. Tidal wetlands throughout the bay are increasingly threatened by ongoing development, degradation, increased flooding, sudden marsh dieback, and other factors (Lathrop 2007, PDE 2008).

Figure 1. The Paddle for the Edge program targets tidal areas of Barnegat Bay between the New Jersey mainland and two barrier islands.

Figure 2. Bulk-heading at Sedge Island near the Barnegat Inlet may prevent erosion, but it also prevents sediment deposition which is necessary for a healthy feedback loop.

In the 2012-2016 Strategic Plan, the Barnegat Bay Partnership (BBP) prioritized tidal wetland assessment, protection, and research. The core piece of this focus was the development and implementation of the Mid Atlantic Coastal Wetlands Assessment (MACWA), a 4-tiered approach to assess New Jersey's wetlands from the landscape level to the site-specific level. Through the course of the MACWA monitoring, shoreline retreat and erosion of marsh areas was identified as a significant issue in Barnegat Bay. This has been confirmed by other remote sensing studies occurring throughout the bay comparing historical shorelines to present day ones (Krause et.al. 2022). While remote sensing is useful to indicate large-scale, long-term changes, it is unable to describe the current condition of a shoreline edge. Direct observation of shoreline edges is necessary to identify areas that are currently showing signs of erosion, classify physical, biological, or anthropogenic characteristics of banks that may prevent or contribute to erosion, and evaluate the ecological functionality of the edge.

Using volunteers to collect this data is beneficial on various fronts. Volunteer images and data provides additional sources of information that researchers could otherwise never acquire. This local information is valuable to innovation and success of the program. Additionally, volunteer participation enhances the societal connection needed to make change by encouraging participation in science and immersion in nature.

The goal of this project is to provide a snapshot of current marsh conditions in relation to long-term changes for natural resource managers via an interactive online data portal. The portal will include data collected by volunteers, historical wetland land use change data, and a filter function to allow users to identify areas in need of restoration based on various characteristics of the marsh edge. It is intended for the data collection and use of the online portal to increase stewardship of local salt marsh habitat.

A5. Project Task Description

Because of the large scale of this project, the BBP created this survey as an annual community science data collection project. By providing the tools to collect high quality data and assist in its interpretation, it is possible to simultaneously promote environmental stewardship and scientific research.

From 2015 to 2024, all volunteers completed identical training tasks and were assigned a section of shoreline to paddle. Low turn out and low-quality data requiring extensive QA led to a new framework to be implemented in 2026. This new framework consists of three "crews" that require various levels of training, data collection, and staff input (Table 1). Volunteers will select their desired level of participation upon registration and will subsequently receive the requirements for training and data collection for the selected crew. Prior to any data collection, all volunteers will undergo various levels of training on scientific terms and how to use the data collection software. Those completing assessments either alone or with BBP staff (Crews A and C) are required to read the training manual to familiarize themselves with the materials. Those completing assessments with a partner in a priority area (Crew B) are required to attend an in-person training event. After completing the training, volunteers in Crew A are welcome to assess shoreline sections of any size at any location (that isn't a priority area). Volunteers in Crews B and C will be assigned an approximately one-kilometer section of the bay to assess. Crew B volunteers will be assigned a section of shoreline within a priority area. Crew C volunteers will be assigned a section near an easily accessible launch site that may or may not be within a priority area. Assessments must be completed within a given a timeframe during the peak growing season.

	Crew A	**Crew B**	**Crew C**
Equipment	Volunteer provides own	Volunteer provides own	BBP provides kayak, paddles, PFD's
Paddle buddy	Volunteer provides own or goes alone	Volunteer provides own	BBP staff accompany volunteer
Location	Volunteer selects own shoreline and launch point	BBP assigns shoreline, volunteer selects launch point	BBP assigns shoreline and launch point
Data collected	Photos only	Photos and condition data	Photos and condition data
Training	Review manual	In-person training	Review manual

Table 1. Requirements of the three tiers of volunteer participation.

From 2025 to 2022, data was collected using a combination of paper datasheets and the Collector app by ESRI. From 2022 to 2024, data was collected solely using the Field Maps app by ESRI. From 2025 on, data collection will be done via the ESRI Survey123 app available for free on any smartphone as long as the app is supported. To complete the assessment, volunteers will paddle to their selected shoreline and photograph a three-meter section of the shoreline. Volunteers in Crew B will be required to select a variety of physical and biological features present within the three-meter section in addition to the required photos. The volunteer will then paddle approximately 30 meters along the shoreline and repeat the process until they decide they are complete (Crew A) or have reached the end of their selected shoreline (Crews B and C). Data from the Survey123 app are automatically entered into a database in real time. A number of shoreline protocols and peer reviewed lists of wetland indicators

were used to develop survey questions (Berman & Hershner 1999, Brooks et. al. 2006, Jacobs et.al. 2006). The indicators used to develop the survey questions were focused on biological and physical edge conditions that could be observed from the water. Survey questions received updates in 2016 and 2025. The updated questions from 2025 are formatted as checklists, allowing for volunteers to select all features observed without limiting the data collected to only dominant or majority features.

Training and data collection will occur in the early summer (Table 2). During mid-summer to early fall, 100% of the points collected by Crew B and C volunteers will be reviewed by BBP support staff using the attached photos. Beginning in 2026, priority areas with poor quality photos will be revisited if necessary to obtain adequate quality photos. Data analysis will take place in the fall/winter of each year. Priority areas to be surveyed in a given year are based on the data gaps from previous years, to be determined by the Program Manager at the start of the year. New areas of the bay will be prioritized each year to assess all of the marsh shorelines in Barnegat Bay within a three-year period, and have each targeted area surveyed on a triennial basis. Areas outside of Barnegat Bay are to be completed at the request of partners and contingent on BBP staff time and alignment with the project goals.

At the conclusion of the survey each year, the data is reviewed, edited, and analyzed to classify the current edge condition and the historic rate of land use change. Survey parameters that indicate signs of erosion are used in an R analysis to classify the condition of the edge at each point. This classification reflects the edge morphology at the time the data is collected. A GIS analysis of land use changes allows us to identify areas that were dry land in 1977 but are now tidally flowed, and areas that were tidally flowed in 1977 and are now dry land. These shifts illustrate historic loss and gain over the last 43 years and support the current edge condition classification for a large-scale representation of marsh edges. The results will be published on an online data portal to be used by restoration managers in identifying potential areas to target for restoration projects.

Activity	**Start**	**Deliverables**	**Due**
Project design	January	Outline, ESRI app updates	1/31
Update training materials	February	Manual, video, webinar slides, etc.	2/28
Create/schedule advertisements	March	Brochure, social media posts, presentations	3/31
Registration	May	Google form	6/30
Survey window	July	ESRI Survey 123	7/31
Data review/analysis	August	Shapefiles, excel sheets	9/30
Reporting	November	Online portal, fact sheet, 3-year report	12/23

Table 2. Schedule of key tasks.

A6. Information/Data Quality Objectives and Performance/Acceptance Criteria

Paddle for the Edge is designed to meet the quality assurance standards of Tier 2 of the Watershed Watch Network's (WWN) Community Water Monitoring Tiered Data Quality Framework, developed by the NJDEP and The Watershed Institute (Appendix I). The study design, standard operating procedures (SOP's), and this Quality Assurance Project Plan (QAPP) qualify the data for use in targeting areas for monitoring, restoration, or assessment, as well as for educational use as indicated in Tier 1. Because the

data will be used as a screening tool and not as a regulatory assessment, data collection by trained volunteers is sufficient.

Precision and Accuracy

Volunteers will be trained on the survey questions to ensure accuracy and precision in data collection. Assessments should be conducted at low tide when features of the edge are most visible and within 20 meters of the shoreline. Data points should be submitted as close to the edge as possible and away from any buildings or structures that may impact GPS accuracy. Other settings and best practices to ensure accuracy and precision are listed in Table 3. Photos should include a clear visual of the shape of the bank, a clear visual of the color/shape of small features, and minimal vegetation covering the edge. Photos missing any of these features will still be accepted but may be flagged for poor quality.

Because volunteer assumptions about morphology have been inaccurate in previous years, 100% of the collected data will be reviewed and edited by trained BBP staff. Following BBP staff review, data are flagged according to the confidence in accuracy. All data flagged "a" or "b" have 100% accuracy. Data that cannot be confirmed will be flagged accordingly and available for use at the users' discretion (Appendix IV).

Setting	**Selection**
Phone: Location	On
Phone: Precise Location specific to Survey123	On
Survey123: Map type	Basic
User position	Open canopy (away from buildings/structures)
User submission timing	Submit in same location as photo is taken (avoid drifting away)

Table 3. Settings/best practices to be used to ensure accuracy and precision of GPS data.

Bias

Volunteers will be trained in proper methodology as one way of limiting bias. All participants wishing to collect data are required to complete identical training tasks both in survey parameters and photo-taking techniques and must collect data with a partner to provide a second perspective. Data collection should occur during low tide during the peak growing season when the full marsh edge is visible so as to avoid spatial bias toward features of the marsh platform.

In office review of 100% of collected points will ensure that the results are not biased by any individual or team. To address bias introduced during the review process due to limitations of a photo, BBP staff are trained on the various survey features. Each BBP staff member will undergo an audit where their review is checked by another staff member to reduce interpretation bias.

Certain spatial and temporal biases are allowable to prevent the collection of unnecessary data. Crew B data collection will be limited to areas of interest to the BBP and all data collection is limited to the peak growing season when the most features are visible.

The Edge Condition analysis is biased toward large-scale features of erosion. The code used for analysis does not account for small-scale conditions that are representative of erosion but not captured through

the survey. Therefore, areas of erosion may be omitted from the analysis and the dataset biased toward large-scale examples of erosion.

Representativeness

Data will be collected approximately every 30 meters along an assigned section to capture +/-30 points in a given priority area. New sections will be made available each year for three years in order to cover the whole bay, at which time an analysis of bay wide conditions can be conducted. The survey has been reformatted as a checklist to include all observed features rather than only dominant or majority features. Data are representative only of the conditions at which the photo was taken.

Comparability

Seasonality and weather may affect answers to the vegetation questions and the recreational use questions. Therefore, the survey will take place at low tide during the peak growing season every year to ensure consistency between years and between areas. Priority areas will be repeated triennially and analyses should compare triennial data.

Completeness

Volunteers in Crews A and B are given in approximately one-kilometer increments with a goal of getting 30 points in each section of shoreline. BBP staff should visit priority areas not completed by volunteers in three years to acquire a complete dataset for the bay. All data points must have a corresponding photo(s) of adequate quality which includes a visual of the shape of the bank, a visual of the color/shape of small features, and minimal vegetation covering the edge. Should data points in priority areas be missing adequate quality photos, BBP staff will revisit the site to acquire photos. Should time/resources prevent staff from revisiting sites, the data will be flagged for quality based on the photos originally submitted.

Sensitivity

The project has been designed in such a way that all metrics can be detected by a person trained to use the terminology and indicators. Due to the qualitative nature of the survey questions, the data is sensitive to collector bias and will be addressed as described above. Documented parameter guidance will be used by BBP staff and the Program Manager when reviewing the data to limit such bias.

The quantitative nature of the GPS data is sensitive to satellite reception of each individual's phone. The built-in sensitivity of modern integrated GPS systems is sufficient for capturing the large morphological features of the marsh edge. Users will be instructed to collect data away from buildings and structures that may inhibit satellite reception and within 20 meters of the shoreline.

The Edge Condition analysis is sensitive only to large-scale features of erosion and omits areas of erosion not captured by the survey. Additionally, the Historic Change analysis is sensitive to land use changes from the NJDEP 2020 Land Use/Land Cover data layer and does not represent current land use changes.

A7. Distribution List

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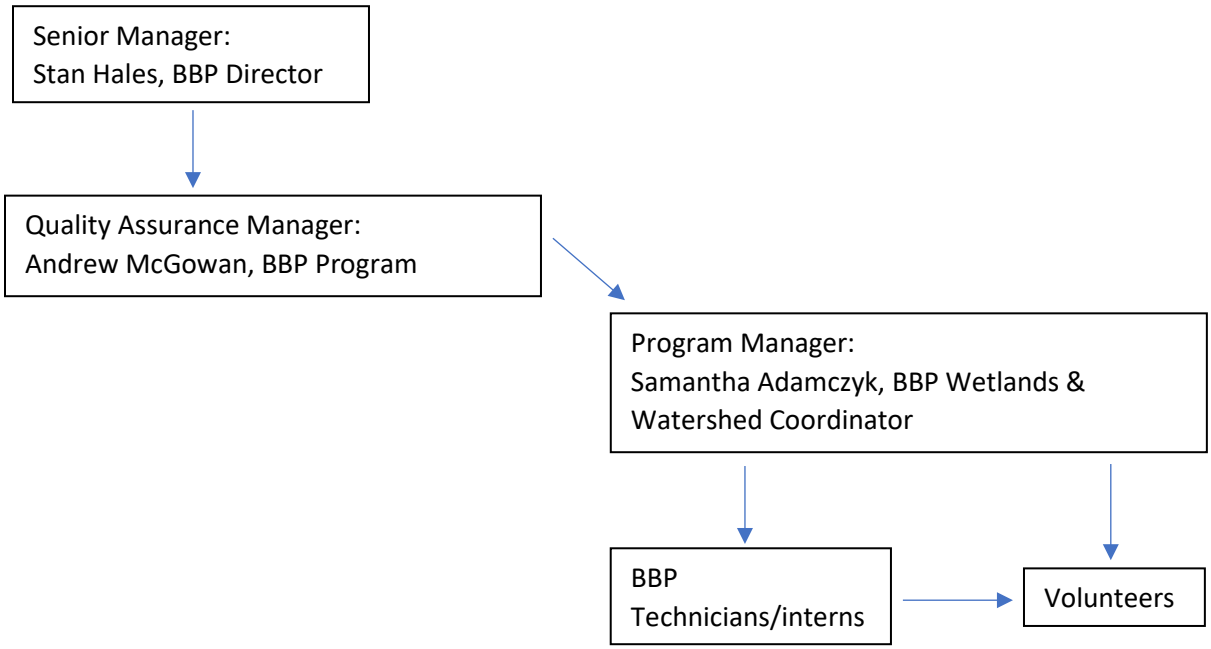
A8. Project Organization

As Program Manager, Samantha will select the study area for a given year and contact partner organizations. She will direct the creation of training and advertising materials with input from the BBP Associate Director of Outreach, Nina Sassano. Technicians and interns (support staff) will assist with the creation of materials. Volunteer registrations and correspondence will go through Samantha and support staff prior to and throughout the survey. Samantha and support staff will provide support to volunteers during the survey window (training, appropriate survey times for each location, answer questions, assist with app issues) and collect any supplemental data. Trained volunteers will collect the data/photos. Support staff will collect data/photos from priority areas not completed by volunteers. Data will be reviewed and analyzed by Samantha and support staff. The BBP Director, Stan Hales, will provide executive leadership including knowledge of personnel, funding, materials, supplies, and time. Andrew McGowan will be responsible for ensuring all QA/QC procedures are followed. Samantha Adamczyk will be responsible for maintaining the QAPP.

A9. Project Quality Assurance Manager (QAM) Independence

The QAM will provide support to the Program Manager in program design to ensure adherence to the QAPP. He will review the Program Manager's and other staff members review of volunteer data to ensure it has been completed as specified in this document as well as the volunteer and staff master training list. He will have no direct communications with volunteers that would affect data collection. He will provide guidance to support staff in program operations. Any concerns regarding data collection or review will be directed to the Program Manager.

A10. Project Organizational Chart and Communications



A11. Personnel Training/Certifications

Volunteers will be required to complete training tasks that will focus on terminology and use of the data collection app. All volunteers will be required to review the training manual and submit a test point (Appendix II). As of 2026, Crew B volunteers must attend in-person training prior to site assignments. Training tasks completed by volunteers will be documented on the master volunteer list, maintained by the Program Manager. BBP staff will provide additional support to volunteers as necessary. BBP support staff will be required to review this QAPP and shadow an experienced staff member in reviewing a minimum of 10 data points. Support staff will all review the same photos of morphological features in order to limit bias in identifying features of erosion. Training tasks completed by BBP staff will be documented on a master staff list, maintained by the Program Manager.

A12. Documents and Records

This QAPP, SOP's, and training materials will be stored on a server that is maintained and backed up every evening by Ocean County College (OCC). Advertising materials will be created and stored on the BBP accounts of various platforms including Canva, Microsoft OneDrive, and the OCC server. Volunteer registrations were previously hosted on Constant Contact. As of 2023, registrations have been and will continue to be hosted on Google forms. At the close of registration, the form will be downloaded and saved to the OCC server. Raw and final electronic data will be stored on the BBP ArcOnline account as well as the OCC server in the Paddle4TheEdge folder. Electronic copies of the data will be used for analysis so the original data remain uncompromised. Data QC sheets will be stored on the OCC server in the Paddle4TheEdge folder. All data will be held for a minimum of ten years after completion of a full survey cycle. The Program Manager will complete updates to the QAPP and SOP's in consultation with the QA Manager on an annual basis before training materials are created, and ensure personnel and

members of the distribution list have access to the most recently approved versions. The newest QAPP will be labeled “final” in the OCC server, and will also be available on the BBP website.

B1. Identification of Project Environmental Information Operations

All volunteers and staff will check the weather and the tides prior to scheduling any field work. Assessments are required to be conducted at low tide during a specified time during the peak growing season and preferably during calm weather to obtain the most accurate and representative data. Google Maps or similar applications should be used to navigate to assigned shoreline sections. As of 2026, priority areas that are inaccessible during the survey window due to weather or tide limitations will either be completed in the fall by BBP staff or skipped and added to the list of priority areas for the following year to ensure completeness within the three-year bay-wide assessment window, depending on staff capacity.

As of 2026, there are varying amounts of data collection depending on the level of participation. Volunteers in Crew A have no maximum or minimum requirement for the number of data points collected. The purpose of Crew A is to provide volunteers who only wish to paddle a specific area each year (an area not of interest to the BBP) with a chance to engage in community science and stewardship. The photos from this crew are not critical to the assessment of the bay. Volunteers in Crews B and C will submit data points approximately every 30 meters until they reach the end of their approximately 1-kilometer section, resulting in approximately 30 data points. An average of 30 points will guarantee comparability to previously collected data priority areas. It is not necessary to measure the exact distance between points due to the nature of the program being an inventory rather than a sample.

Crew A volunteers will take photos of the marsh edge at each data point which will automatically capture the geographic coordinates of their location. Because Crew A participants do not answer Survey123 questions, paddling alone is possible. Volunteers in Crews B and C will record data in addition to taking photos. To increase accuracy and limit bias in the data collected, volunteers in Crews B and C are required to go out with a partner (Crew C goes out with a BBP staff person). The survey questions selected for volunteers to complete will be a selection of parameters from the original survey completed in 2015 in order to maintain comparability with data from previous years (Table 3). Survey questions will capture basic marsh features as well as indicators of erosion and accretion. The data review process will occur in late summer to allow time to revisit sites if necessary. Although the field assessment collects small-scale data, targeted analyses using secondary data can be performed by BBP staff to account for large-scale heterogeneity within a section (Appendix V).

B2. Methods for Environmental Information Acquisition

As a community science program, data collection follows non-standard methods that will allow use of the data for targeting purposes as defined in the Community Water Monitoring Tiered Data Quality Framework Tier 2. To increase accuracy and precision, data collection is prefaced by various training tasks depending on the volunteer’s crew. Volunteers are first required to review the training manual that illustrates the process of collecting data and defines the survey parameters. Attendance at an in-person training is mandatory for Crew B volunteers to highlight specifics not included in the manual and test their knowledge. Crew C volunteers do not need to attend in-person training since a trained BBP

staff person will accompany them on their assessment. All volunteers will then submit a test point via the Survey123 app to demonstrate their ability to complete the assessment.

Because this project is designed as a qualitative community science survey, there are limited equipment requirements, all of which have no impact on data quality. Volunteers in Crews A and B will need a personal kayak, canoe, or paddleboard and safety gear. The BBP will provide such materials for volunteers in Crew C. All volunteers must have a smartphone with the Survey123 app installed. The Survey123 application is a free app developed by ESRI that allows users to record data based on geolocated information. The BBP purchased a subscription and created a survey in ArcOnline to collect the data specific to this project. Access to the survey can and will be limited to those whom the BBP gives permission, limiting the survey to those who have undergone training. The process of recording data using the ESRI Survey123 application has been tested by multiple members of the BBP staff on different phones and will also be tested by volunteers at training to ensure accuracy of the geolocation on an individual's phone. Inaccurate geolocations will be manually edited to the geolocation from the corresponding photo(s) during the review process.

Survey questions capture a range of physical and biological features of the marsh edge (Table 4). Volunteers receive training on the definitions of the various parameters and tips on what to look for in the field. Select parameters that indicate erosion are used in an R analysis to classify each point according to the condition at the marsh edge (Table 5).

Survey Parameters 2015	Survey Parameters 2016-2023	Survey Parameters 2024	Survey Parameters 2025
ObjectID	ObjectID	ObjectID	Name
Index	Index	Index	**Physical Features: Perpendicular bank shape**
Latitude	Latitude	Latitude	**Physical Features: Undercut bank shape or cantilever**
Longitude	Longitude	Longitude	**Physical Features: Tiers**
Date	Date	Date	**Physical Features: Slumping**
Water	Tidal Stage	Tidal Stage	**Physical Features: Chunks**
Tidal Stage	Heading onshore, the area behind your edge is:	Heading onshore, the area behind your edge is:	Physical Features: None
Depth of water from marsh surface	How high is the bank?	How high is the bank?	Physical Features: Other
The area behind your edge is:	The area behind your edge is:	The area behind your edge is:	Biological Features: Mussels
The area behind your edge is:	Describe the predominant edge plants in your 10 foot section:	Describe the predominant edge plants in your 10 foot section:	Biological Features: Oysters
Describe the predominant edge plants in your 10 foot section:	Is the soil you see mostly:	Is the soil you see mostly:	**Biological Features: Exposed Roots**
How many mussels do you see?	How many mussels do you see?	How many mussels do you see?	Biological Features: None
How are the mussels distributed?	How many fiddler crab burrows do you see?	How many fiddler crab burrows do you see?	Biological Features: Other
How many fiddler crab burrows do you see?	**Describe the shape of the bank:**	Do you see oysters?	Marine Debris: Plastic
Do you see crabs on the bank?	**Do you see exposed roots?**	**Describe the shape of the bank:**	Marine Debris: Metal
Describe the shape of the bank:	**Is the bank cantilevered?**	**Do you see exposed roots?**	Marine Debris: Glass
Do you see Bare Soil?	**Is the bank tiered or step-like?**	**Is the bank cantilevered?**	Marine Debris: Construction debris
Do you see exposed roots?	**Are there chunks or pieces of the marsh in the water?**	**Is the bank tiered or step-like?**	Marine Debris: Biodegradables
Is the bank cantilevered?	Have you passed any ditches since your last point?	**Are there chunks or pieces of the marsh in the water?**	Marine Debris: Biohazard
Are the edges fragmented and clumpy?	How many people do you see?	Have you passed any ditches since your last point?	Marine Debris: Environmental hazard/toxin
Are there chunks or pieces of the marsh in the water?	What are they doing?	How many people do you see?	Marine Debris: Miscellaneous
Do you see manmade structures	What structures are in the water or on the edge?	What are they doing?	Marine Debris: None
What structures are in the water or on the edge?	Comments	What structures are in the water or on the edge?	Comments
What condition is the structure in?		Comments	
Have you passed any ditches since your last point?			
Do you see litter?			
Do you see people on the marsh?			
How many people are Swimming, Wading or Walking?			
How many people are crabbing or fishing?			
How many people are sailing or paddling?			
How many people are boating (motor?)			
How many people are using Jetskis?			
Are people doing other activities?			
Comments			

Table 4. The survey parameters collected each year. Bolded parameters are used in Edge Condition analysis.

EROSION	ACCRETION	STATIC
Undercut shape	Gradual slope shape	Perpendicular shape
Cantilevered shape	No erosion features	No erosion features
Tiered shape		No accretion features
Chunks present		
Slumping present		
Exposed roots present		

Table 5. Conditions required for each edge condition classification. At least one criterion must be present for Erosion classification. All Accretion and Static criteria must be met

Volunteers are asked to complete their assessment at low tide during the peak growing season to ensure representativeness. Upon arrival at their section of shoreline, volunteers assess a three-meter section of shoreline and record their observations/photos in the Survey123 app. After submitting a data point, volunteers will paddle approximately 30 meters and repeat the process until they reach the end of their section.

Volunteers will be instructed at training to indicate any issues in the comments section of the form, or as a last resort to e-mail the Program Manager. Should the survey not work for volunteers (survey will not open, no cellular reception, points do not submit, etc.), they may take photos using their phone's camera app (with the phone's location setting on) and an online file folder will be provided for them to share their photos. The data point can be manually added with the photo at a later date by BBP staff. Should a Crew B volunteer be unable to complete their assessment due to illness, weather, or time constraints, the assigned section will be completed by BBP staff or another volunteer, or added to the next year's target area.

B3. Integrity of Environmental Information

No physical samples or datasheets are collected; the data are transferred from the user's phone to an ArcOnline database in real time. To ensure the accurate transfer of date and location data, all test points will be reviewed by BBP staff during the training period. Any issues will be corrected by the Program Manager with the assistance of ESRI representatives prior to the opening of the survey window.

B4. Quality Control

Volunteers who have not completed the required training for their crew are not permitted to gather data. This is verified by using the volunteer master list with records of training completion. Communication via social media and email will be ongoing to encourage mindful data collection and reduce inaccuracy/bias. Upon completion of data collection, a full review of the data will be completed by BBP staff as described in *Environmental Information Review* below. Any priority area with limited or insufficient data will be revisited by BBP staff as time and resources allow. 100% of the data collected by Crew B and C volunteers will be QC'd. Photos collected by Crew A volunteers will be uploaded to the portal.

Upon completion of the review process, an error analysis will be conducted by the Program Manager to determine the degree to which volunteers take accurate data (% of instances data needed to be

corrected by BBP staff). Such information will be used to adjust the training materials for the following year.

The QA Manager will review the record of the Program Manager and other staff member review of ten randomly selected data points for each data reviewer. The QA Manager will also review the master list of volunteers and staff members to ensure all who participated were trained. A short document attesting to this will be completed by the QA Manager.

B5. Instruments/Equipment Calibration, Testing, Inspection, and Maintenance

Testing and maintenance of smartphones is the responsibility of the volunteer. Prior to using the Survey123 app, users should ensure their smartphones are charged and in working order. A test point is required by each volunteer during training to ensure that the smartphone is receiving signal and capable of collecting the necessary data. Test points will be reviewed by the Program Manager and issues addressed with the volunteer prior to their assessment period.

B6. Inspection/Acceptance of Supplies and Services

The Paddle for the Edge program requires an active Educational Academic Departmental Annual subscription to ESRI. The number and size of subscriptions needed to accommodate the following year's Paddle for the Edge volunteers must be determined prior to the November 30th expiration. The Program Manager will discuss needs with the BBP Wetland & Watershed Manager who will then process the renewal.

B7. Environmental Information Management

Data collected using the Survey123 app is automatically entered in real time into a database housed on ESRI's arcgis.com cloud. At the conclusion of the data collection period, the Program Manager will download the data from the cloud to be backed up on OCC servers. They will be copied for data processing and storage. To detect errors and prevent data loss, each step of data processing will be performed on a copy of the previous data file (Appendix III). During the review process, different colors will be used on the QC sheet to identify edits and comments made by the Program Manager and support staff. Final data will be copied to the Paddle4TheEdge folder on the OCC server and then uploaded to the Paddle for the Edge Data Portal. The portal includes information on all the flags assigned by the Program Manager or BBP staff reviewing the data. Only data that has been reviewed by the Program Manager or delegated BBP staff person is entered into the portal.

C1. Assessments and Response Actions

The Program Manager and QA Manager review the QAPP annually to ensure accuracy and identify necessary changes. A new version (if necessary) is saved as "final" and replaces the QAPP on the website.

Completion of training for both volunteers and staff are saved in master lists for each assessment year. This information is accessed by the Program Manager to ensure only those who have completed

trainings participate. It is also accessed by the QA Manager at the end of the season to ensure data were collected only by trained personnel.

Prior to the survey window, the Program Manager will conduct a competency assessment of the test points submitted by volunteers. Test points will be reviewed and comments will be provided to volunteers on more effective data collection methods. A memo summarizing the results of the competency assessment will be saved on the OCC server.

During the survey window, the Program Manager will conduct periodic reviews of the submitted data and provide additional support to volunteers as necessary. Volunteers will be instructed to contact the Program Manager if there are any issues while collecting data. These issues will be noted and fixed where possible. Comments from volunteers that could help others' data collection will be shared with volunteers as the project progresses. A memo summarizing volunteer issues/concerns will be saved to the OCC server.

Following the survey window, the Program Manager will audit 10 of the first 50 points QC'd by each support staff to ensure consistency in the QC process. A second staff person will review an additional 10 of the next 50 points. Any errors will trigger a full review of all 100 points. The audit process continues with another 10 out of 50 points until no errors are noted. The audited support staff member can then conduct reviews without further audits. This process is conducted for each staff member performing reviews. Audit results are saved by the Program Manager to the OCC server. The QA Manager reviews these records before data analysis for edge condition to ensure that all staff persons performing review were trained and assessed. This, along with a master training list is used by the QA Manager to ensure data have been collected according to this QAPP.

At the end of year, the Program Manager, QA Manager, and support staff will meet to evaluate the project, identify shortcomings and deviations from the QAPP, and ways to correct these issues in the future. A memo summarizing these findings will be saved to the OCC server. Any deviations from the QAPP result in all the data collected under that deviation being flagged. The decision to preserve or delete that data is made by the QA Manager, potentially with advice from outside experts at NJDEP or other partner agencies.

C2. Oversight and Reports to Management

The QA Manager produces a short document attesting to the training and auditing procedures listed in this document. This report is shared with the EPA annually.

Interim fact sheets will be produced either internally or for partner distribution annually by the Program Manager or support staff. Updates to the HUB will be completed quarterly by the Program Manager and support staff. The Program Manager or support staff will prepare a final report each time the complete watershed is surveyed (approximately three years) and share with partners.

D1. Environmental Information Review

The Program Manager and support staff are responsible for verifying the data through an intensive review process using ArcGIS Pro at the Program Office. Staff will use documented procedures to compare the data to the photos, make any changes necessary, and flag each parameter for data quality

(Appendix IV). Each staff member conducting data reviews will undergo an audit. After a total of 50 points have been reviewed by a staff member, the Program Manager will randomly select ten points to double check and address any inconsistencies or concerns. Inaccuracies in the random 10 points will trigger a full 50-point review by the original technician followed by another 10-point audit by the Program Manager. After a total of 100 points have been reviewed by that staff member, another staff member will randomly select ten points to double check and address any inconsistencies or concerns. It is acceptable for the second reviewer to randomly repeat points reviewed by the Project Manager. Inaccuracies in the random 10 points will trigger a full 50-point review by the original technician followed by a 10-point audit by the additional staff member. Once the second 10-point audit passes with no inconsistencies, no further audit is necessary and the staff member may continue reviewing the rest of the dataset.

Attempts will be made to determine validity of volunteer answers from the photos for all Crew B and C submissions. Incomplete points may be omitted from some of the data analyses; incompleteness does not automatically disqualify a point from all analyses. Records of incomplete points will be maintained with the appropriate flags for each parameter. Data points missing all "erosion" data (cantilever, tiers, undercut, and chunks) are omitted from the Edge Condition analysis but may be included in the Historic Change analysis. A complete annual dataset will consist of the corrected and flagged data for all shoreline sections assessed in a given year with their associated photos.

The Program Manager and the QA Manager are responsible for validating the data through ensuring its compliance with the QAPP and its usability in the Edge Condition analysis. The final dataset will be reviewed by the Program Manager to ensure the acceptance criteria are met and perform analyses to be published on the online portal (Table 6). Any criteria not met will be addressed and resolved by the Program Manager, and a memo document stating all concerns will be saved on the OCC server with the final dataset.

The final dataset will be accepted given that it meets all of the following criteria:

Criteria	**Quality Objective**	**Method of Assurance**
Volunteers and staff completed training tasks.	Precision/accuracy, bias	In-person attendance recorded.
Crew B volunteers/staff collected data with a partner.	Bias, sensitivity	Partner recorded on volunteer registration sheet.
All assigned sections were completed by either volunteers or BBP staff during the survey window.	Representativeness, comparability, completeness	Completion identified via survey map and recorded on volunteer registration sheet.
Data was reviewed, corrected, and flagged by BBP staff, including Program Manager and peer checks.	Precision/accuracy, bias, sensitivity	Edits recorded on QC sheet; audits recorded in separate audit report.
All data has a corresponding photo(s).	Precision/accuracy, completeness	Missing photos recorded on QC sheet. Sites revisited and data/photo recorded on QC sheet.

Table 6. Final dataset acceptance criteria. Accepted data will be published on the portal and shared with partners.

D2. Usability Determination

Following completion of data verification and validation, the Program Manager will determine the percentage of volunteer data that needed to be corrected for both edge condition parameters and miscellaneous parameters. The most commonly incorrect features will be highlighted in an internal error report for use in adjusting training materials. The Program Manager and QA Manager will meet to discuss if parts of any data need to be adjusted or discarded during data analysis or data sharing because of errors. Any alterations to data will be noted and disclosed to those using the data. The Program Manager and QA Manager will also discuss if there are any data quality issues that prevent the data from being used, and if the data is sufficient for its intended purpose of assessing the current morphology of the shorelines in Barnegat Bay. Reasons that may limit the data from being used as intended may include incomplete points, too few points per assignment, or frequent issues with data verification.

The final dataset will undergo various analyses to be published on the online portal for public use. The portal will include a filter function allowing users to select the data applicable to their desired use in identifying areas in need of restoration. A long-term bay wide evaluation of the condition of marsh shorelines has many possible additional uses. Any additional use of the data will need to separately evaluate whether the data collected via this QAPP meets the requirements for that particular use and should not exceed uses beyond Tier 2 of the WWN framework.

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Appendix I: Watershed Watch Network's Community Water Monitoring Tiered Data Quality Framework

New Jersey Watershed Watch Network | A Program of The Watershed Institute and New Jersey Department of Environmental Protection

Table 1. Community Water Monitoring Tiered Data Quality Framework

In general, the amount of time, money, and expertise required increases with the tiers.

	Data Uses	General Requirements
TIER 1	• Community education • Municipal engagement	***Study design*** available for review by potential data users, with: • Documentation of methods, locations, and timeframe
TIER 2	Includes Tier 1 uses, plus: • Project-specific monitoring • Water quality report cards • BMP effectiveness monitoring • Targeting installation of BMPs • Targeting advanced monitoring • NJDEP Comprehensive Regional Assessments	***QAPP***[1] approved at Tier 2 by NJDEP BEARS[2] or NJ Watershed Watch Network with: • Use of standard operating procedures with defined levels of accuracy and precision
TIER 3	Includes Tier 2 uses, plus: • Regulatory assessments of water quality standard attainment	***QAPP***[1] approved at Tier 3 by NJDEP Office of Quality Assurance, with: • Use of NJDEP-Certified field and/or laboratory methods for chemical and microbiological analyses • Use of EPA Rapid Bioassessment Protocol for habitat assessments • Use of a defined NJ Watershed Watch Network method for macroinvertebrates (see Table 2)

[1]*QAPP = Quality Assurance Project Plan, a technical document that describes exactly how your data is being collected, analyzed, and stored for future potential data users to review. NJ Watershed Watch Network will help you to prepare according to the guidelines set forth by NJDEP Office of Quality Assurance and the EPA Citizen Science Handbook.*

[2]*NJDEP Bureau of Environmental Assessment, Restoration and Standards*

Appendix II: Paddle for the Edge Volunteer Training Manual 2024

P4E2024_manual.pdf

Appendix III: File Management

File Name	File Type	Description	Data Source
P4E_*Year* _staff	excel sheet	record of staff trained for data review	Program Manager - Microsoft Excel
P4E_*Year* _volunteers	excel sheet	record of volunteers registered	Program Manager - Microsoft Excel
MEMO_P4E_*Year* _TestPoints	word doc	note of success/challenges of volunteer test points	Program Manager - Microsoft Word
MEMO_P4E_*Year* _SurveyFeedback	word doc	notes from volunteers during data collection	Program Manager - Microsoft Word
ex./949b870ca422413a81e6da95d7aa4d78.gdb	geodatabase	raw data downloaded from ArcOnline	BBP staff - ArcOnline
P4E_Year	ArcGIS map	map created using ArcMap or ArcGIS Pro	BBP staff - ArcGIS
P4E_Year	geodatabase	storage folder for manipulated data	BBP staff - ArcGIS
P4E_Year_raw	data layer	raw data downloaded from ArcOnline	volunteers - Collector, Field Maps, or Survey123 app
P4E_Year_edits	data layer	copy of raw file with columns for GPS coordinates	BBP staff - ArcGIS
P4E_Year_QC	excel sheet	excel sheet documenting changes made and QC flags	BBP staff - Microsoft Excel
P4E_*Year* _audit	excel sheet	record of review success/failure for each staff member	Program Manager - Microsoft Excel
MEMO_P4E_*Year* _QC	word doc	note of concerns during the QC process	Program Manager - Microsoft Word
P4E_Year_photos	folder	downloaded photos	BBP staff - ArcGIS
P4E_Year_photos	geodatabase	downloaded photos	BBP staff - ArcGIS
P4E_Year_invalid	excel sheet	list of invalid photos	BBP staff - ArcGIS
P4E_Year_edits_flags	R table	combination of edited data and associated flags	BBP staff - R
P4E_Year_edits_clean	R table	edited and flagged data excluding "i" flagged records	BBP staff - R
P4E_Year_EDGE_full	R table	cleaned data with EDGE analysis column	BBP staff - R
P4E_Year_EDGE_flags	R table	only EDGE analysis and flag columns	BBP staff - R
P4E_Year_EDGE_flags	excel sheet	only EDGE analysis and flag columns	BBP staff - Microsoft Excel
P4E_Year_EDGE_full	data layer	cleaned data combined with EDGE_flags	BBP staff - ArcGIS
P4E_Year_buffer	data layer	EDGE data within 25 meters of shoreline	BBP staff/NJDEP data - ArcGIS
P4E_Year_snapped	data layer	buffered data snapped to nearest shoreline	BBP staff/NJDEP data - ArcGIS
P4E_Year_snapped_change	data layer	snapped data with CHANGE analysis column	BBP staff/NJDEP data - ArcGIS
P4E_Year_EDGE_CHANGE	data layer	fully cleaned dataset with EDGE and CHANGE analysis columns	BBP staff/NJDEP data - ArcGIS
P4E_Year_EDGE_CHANGE	geodatabase	storage for final data upload to HUB	BBP staff - ArcGIS/ArcOnline
MEMO_P4E_*Year* _EOY	excel sheet	note of success/challenges for the year with action items for following year	Program Manager - Microsoft Word

Appendix IV: Data Review Standard Operating Procedures

Data SOP.pdf

Appendix V: Data Analyses Methods

AnalysisMethods.pdf